vigias of navigators in different parts of the greater oceans. From this and other evidence, I am very well satisfied that not only the Pacific, but also the North and South Atlantic and the Indian Oceans, are areas of depression.

Having thus roughly mapped out the world, it becomes an interesting problem to correlate the distribution of volcanoes with that of the rising and sinking land. If the older theory of volcanoes be the true one, that they are the direct results of the eruptive forces of the interior of the earth, we ought surely to meet with them in profusion in those large areas where we know the earth to be relatively rising, where in fact the eruptive force of which volcanoes are the supposed violent proofs is concentrated. Is this so? On the contrary; and it is this that forms the burden of my present letter. The fact is that we shall search in vain among the large areas of upheaval except along their boundaries and fringes for any active volcanoes. Take the northern circumpolar region, the most typical area of rising land in the world, and there is absolutely no volcano in it. The Iceland volcanoes and Jan Mayen happen to be outside the area of upheaval, and in a part of the Atlantic which is notoriously sinking. North America, another large area of rising land, is similarly bare of volcanoes. So is South America, save on the very verge of the Pacific, and that part of the Pacific which I believe to be sinking most rapidly. Australia is probably now rising faster than any area in the world save Spitzbergen, and there we have no volcanoes. Europe is similarly free except in that part of it which is sinking, namely, the Mediterranean border. Lastly, there is the vast continent of Asia, a large part of whose northern surface seems, from all the evidence we can collect, to have been quite recently under water and to be still rising. About Asia I wish to enlarge somewhat.

It was one of the peculiar fancies of Alexander Humboldt, the great authority on the Physical Geography of Asia, that there was a large active volcanic region in the Altai Mountains, &c., and he brought together a great deal of plausible matter to support this view.

As this volcanic region would be in the midst of one of the largest areas of elevation on the earth's surface, it would conflict materially with the evidence elsewhere and with the theory of the distribution of volcanoes for which I am arguing. Luckily for me it has been recently shown, so far as the negative results of those who have been to find Humboldt's volcanoes and have not found them, goes, that is, so far as the only scientific witnesses who have surveyed the region may be allowed to dogmatise, that Humboldt was entirely mistaken. I will quote the accounts of the Russian surveyors as they have been translated for the Geographical Society.

"It now remained for me," says Semenof, "to prove by actual observation the existence or otherwise of volcanic phenomena in Djungaria and in the Celestial Mountains, to which Humboldt in his works so often alludes. I started on my journey, firmly persuaded that I should find the conjectured volcanoes, or at all events some volcanic forms, and sought diligently (as Schrenck did on Lake Ala-kul) to establish the correctness of Humboldt's surmises with respect to the existence of volcanic phenomena in Central Asia, by which confirmation I knew a traveller would gain greater credit than by any incomplete refutation of the supposition. I was even aware that Humboldt was rather displeased with the researches of Schrenck, who clearly showed that the island of Aral-Tübe on Lake Ala-kul was not of volcanic origin. The opinions entertained by Humboldt on the subject of the existence of volcanoes in Djungaria were favourite ones with him, and I regret that I was not able to confirm his cherished theory. Kullok Peak, another of Humboldt's mistaken volcanoes, was found to have no volcanic origin whatever. The hot springs and the non-congelation of Lake Issyk-kul were not accompanied by any volcanic forms in the Tian Shan; and furthermore, all the native accounts of phenomena which from their description might be supposed to be volcanic proved unfounded, and were at once disposed of on my examination of the localities where they were declared to occur. The result, therefore, of my researches on this point was that I became convinced of the complete absence of volcanoes, typical volcanic phenomena, or even volcanic forms, throughout the Celestial Mountains. It is true that there existed in Djungaria at one period some solfatara, or smoking apertures, from which there was a discharge and deposit of sulphur, and that some of these fissures, out of which the Chinese obtain sulphur, emit smoke even at the present day. But a careful inspection of one of the extinguished pits satisfied me that, at all events in that case, there was no volcanic affinity. In the neighbourhood of the pits discovered by me in the Kater Mountains and in the Ili Valley, I could trace no volcanic forms. . . . The whole process of the formation of sulphur can then in my opinion be reasonably explained by the combustion of some coal seams in this basin, which would at once set at rest the question of supposed volcanic agency. . . . The observation of a single portion of the Tian Shan visited by me cannot serve as positive evidence of the absence of volcanoes and volcanic forms in other parts of this mountain chain. My conclusions on this question generally have already been made public in the letter referred to, but I must likewise observe in addition that all Asiatic accounts of phenomena which might be volcanic in appearance should be treated by men of science with great circumspection, as many of these accounts have already proved fallacious. I would here also remark that the impression produced on me personally by Djungaria and the Tian Shan leaves great doubts in my mind as to the existence of volcanoes in this part of Asia; and as I am the only traveller who has visited the Tian Shan, I cannot accept the belief in their existence as an axiom requiring no proof or confirmation. My conclusion on this point, though only negative, is one of the most important results of my journey." ("Djungaria and the Celestial Mountains," by P. P. Semenof, Journal of the Royal Geographical Society, 35–213.) Again, I will quote a later traveller, Mr. Severkof. He says—"There are no volcanic formations in the western portions of the Tian Shan which I surveyed. From eastern sources, Humboldt refers to evidences of volcanic action farther south in the Ak-tan, but even these are doubtful. Fire may be produced in the mountains even by the ignition of the seams of coal as well as of the carburetted hydrogen gas filling the caverns of the seams. This conjecture is supported by the circumstance that Messrs. Bagaslouski and Lehmann discovered, on their journey to Bockhara, a burning seam of coal in the mountains of the upper Zaraphan, a little to the south of the Ak-tan. Speaking generally of volcanic action in the Tian Shan and the surrounding regions, the geological surveys hitherto made from Khan-tengir (east of Issyk-kul, near the sources of the Tonta, Djergalan, Tekes, and Kegen) to the extreme western limits of the system, have given only negative results. To the east of Khan-tengir there are again seams of coal—for instance, at Kuldja, and perhaps also at Urumchi—the ignition of which is quite sufficient to create explosive gases. Whether the seams of coal were ignited at Urumchi by volcanic agency, or accidentally at their denudations, is a question that cannot be settled without close observation. It can only be said that the demonstrations in favour of volcanic action adduced by Humboldt are not sufficient proof of the volcanic origin of the Tian Shan, excepting only as regards the lava which, according to Chinese records, flowed from the Peshan mountain during the 6th century. But a single crater—even if the fact of its existence in an extensive mountain system extending, as the Tian Shan does, for 3,000 versts, can be proved—does not make the whole of the range volcanic. (Severkof's "Journey to the western portion of the Tian Shan," Royal Geographical Journal, 40, 395–6.)

This evidence, to my mind, completely refutes Humboldt, and makes it very clear that his volcanic region is non-existent. With the disappearance of this, disappears the only exception I know to the rule that volcanoes, instead of being found chiefly on areas of elevation, are invariably found in areas of depression, or on or close to the boundary lines which separate them from the areas of elevation. The meaning of this lesson, as I read it, I will reserve for another letter.

In conclusion, I wish to thank one of your correspondents in Tasmania for the fact he communicated to you about the rise of that island. I shall be very grateful to anyone who will send me other facts about areas of upheaval and subsidence, and their communications shall be cheerfully acknowledged when I publish them.

Derby House, Eccles HENRY H. HOWORTH

Spectra of Shooting Stars

IT may interest observers of shooting stars who attempt to obtain views of their spectra by the use of suitably adapted meteor-spectroscopes to indicate a peculiarity which seems to distinguish the larger meteors of the December star-shower, radiating annually from the direction of a point near θ Geminorum on the nights of the 10th, 11th, and 12th of December. Two such small bolides of this stream which appeared to me on December 9th, 1864, and on Thursday night last, the 11th inst., were characterised by a beautiful pale-green colour, like that of

© 1873 Nature Publishing Group

the thallium flame in purity of tint, but perhaps of a slightly paler or lighter hue, and it remained uniform like the brightness of these meteors as long as they remained in sight, strongly suggesting that either copper, barium, thallium, silver, or some other element giving, in some of its combinations, an intensely green spectrum, was undergoing vivid ignition in their flame. As each of these bright meteors presented a sensibly round disc (the first several times brighter, and the second a little brighter than the planet Jupiter), without visible sparks or train of any other colour than that of the head which could give rise to the green colour by the effect of contrast, and yet the green hue was much more distinct than I have noticed in any other meteors, not omitting some bright ones accompanied by very ruddy streaks in the principal displays of November 14, it appears to be a distinguishing feature of the brighter meteors of the annual star-shower of December, to which it would be very useful on occasions of its future return to direct particular attention. The meteors of this star-shower are, however, seldom of very considerable brightness, and the occurrence of one such during its recent appearance not improbably marked its return during the present year with somewhat more than ordinary intensity. The meteor was simultaneously observed at Glasgow and at Newcastle upon Tyne, and its apparent paths among the constellations at those places, directed from the usual radiant point in Gemini, with the duration of its flight, will enable the real height and the speed of motion of one of the principal meteors of the shower to be pretty exactly ascertained.

During many hours of repeated observations under the most favourable conditions of the sky on the nights between the 23rd and the 30th ult., and again on the 5th of this month, when observers for the return of the shower of meteors belonging to Biela's comet were on the watch for its appearance at different places in England, Scotland and Ireland, the reports of their observations which have hitherto been communicated to the Luminous Meteor Committee of the British Association have been entirely negative, scarcely a single meteor of the few which were observed being recognised as belonging to the well-known radiant-point of the shower, which was so conspicuous last year in Andromeda. At various times during the night of the 27th of November itself, when the sky was generally clear, no meteors of this description were visible, and their absence on all the other nights when the state of the sky permitted a watch to be kept for them scarcely leaves any reasonable grounds for the supposition that even a comparatively insignificant return of last year's meteor-showers of the 24th and 27th of November has this year been visible in England on the same or on any very nearly adjacent dates.

A. S. HERSCHEL

Newcastle-on-Tyne

Meteor Shower

FROM the reported weather in England it seems improbable that the Geminid meteor shower was well observed in England, and as the return was rather above the average a few particulars of what was seen here may at least be interesting.

The nights of the 10th and 11th, when the watch was kept, were exceedingly clear. Except for a quarter of an hour at the commencement of the first watch there was only one observer, then there were two. The position taken was a window, N.E., whence all was visible from about 3° from the zenith to the hills opposite (perhaps 10° or 15°), behind which only one meteor disappeared, whilst only one was noticed whose course was part hidden by the roof. The average per hour on the $1\frac{1}{2}$ hours' watch on the 10th must have been about 38, and on the 2 hours' watch on the 11th, 60. But the rate in the second hour was much in excess of the first; taking the two thus the result is, from 10–11, about 30, from 11–12 about 88. In all probability the rate would have not been much below in the morning hours, but having a cold I did not stop longer.

The brightness was, I think, rather below the average, but as tabulated it was as follows :—

Bright as Jupiter	1
,, Sirius	2
,, 1 magn. *	9
,, 2 ,,	17
,, 3 ,,	10
,, 4 ,,	23
,, 5 ,,	2

A comparison with the radiant points in Mr. R. P. Grey's list makes it seem that the meteors were distributed over at least *nine*, and that two of these are ones not included by him. Of these one seems pretty certainly fixed about R.A. 57° N.8 6°, and to this I have assigned 14 on the two nights. The other is more doubtful, two nearly parallel meteors appeared on the 10th, opposite in direction to the others ; their point may be about R.A. 275° N.δ. 60°.

An apparent discrepancy in the total seen and the tabulated numbers is explained by the fact that some meteors were not well enough seen to be entered. But on the regular watch of the 11th I had the unusual success of entering every one seen, in consequence I believe of the position I had assumed, *i.e.* seeing less than half the heavens and *lying* on my back. Several cases of almost, or perfectly, simultaneous meteors appeared, but of these only 4 pairs were from the same radiant.

J. EDMUND CLARK

Heidelberg, Dec. 16

THE LATE PROFESSOR DE LA RIVE

SWITZERLAND has in one month been shorn of two of her most distinguished ornaments. De La Rive and Agassiz have died within a fortnight of each other, and the "Académie des Sciences" has thus been deprived in the same month of a fourth of its Foreign Associates. Agassiz will no doubt find, both in Switzerland and America, more than one pen competent to describe his labours in the field of science ; but a few lines on the life and researches of de la Rive are due to this distinguished philosopher, and will be read with interest in this country, which he has often visited, and in which he had many friends.

Born at Geneva in 1801, of an old family closely connected with Cavour, Auguste de la Rive inherited from his father the love of science in general, and more especially of electricity. After going through the usual course of studies with brilliant success, he was, at the early age of twenty-two, called to the Chair of Natural Philosophy in the Academy of Geneva, and took his seat amongst the distinguished men of that city.

Although de la Rive devoted his time principally to the study of the different branches of electricity and their numerous applications, his acquirements were not limited to that department of science. During the earlier part of his career the subject of specific heat, more particularly applied to gases, and a series of experiments on the temperature of the crust of the earth, were published by him conjointly with a friend and colleague. But electricity remained his favourite study to the end of his life. The treatise he published between the years 1853 and 1858, in three large octavo volumes on the subject of electricity, translated into English by Mr. C. Walker, F.R.S., and the numerous original articles which appeared in the well-known monthly journal, *Les Archives d'Electricité*, for many years under the direction of de la Rive, afford ample proof of the extent of his information on all subjects connected with his favourite pursuit. His original memoirs on electro-dynamics, magnetism, the connection of magnetism with electricity, the nature of the voltaic arc, and on the propagation of electricity in the interior of bodies, more especially through extremely rarefied media, and others too numerous to be quoted, ensured him a high European reputation, to which was soon added the title of Member or Correspondent of almost every scientific body in Europe. In 1840 he was named Correspondent of the French Académie des Sciences ; in 1846, Foreign Member of the Royal Society, and finally in 1864 he was elected Foreign Associate of the Académie des Sciences, the highest honour to which a man of science can aspire.

It was de la Rive who first conceived the idea of applying the force of electricity, through the means of alkaline solutions, to the gilding of silver and brass, and

© 1873 Nature Publishing Group